

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Electrical insulating materials – Determination of the effects of ionizing radiation –

Part 1: Radiation interaction and dosimetry

Matériaux isolants électriques – Détermination des effets des rayonnements ionisants –

Partie 1: Interaction des rayonnements et dosimétrie



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ELECTRICAL INSULATING MATERIALS –
DETERMINATION OF THE EFFECTS OF IONIZING RADIATION –****Part 1: Radiation interaction and dosimetry**

FOREWORD

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International Standard IEC 60544-1 has been prepared by IEC technical committee 112: Evaluation and qualification of electrical insulating materials and systems.

This third edition cancels and replaces the second edition published in 1994 and constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) recent advances in simulation methods of radiation interaction with different matter enables the prediction of the energy-deposition profile in matter and design the irradiation procedure;
- b) many new dosimetry systems have become available.

The text of this standard is based on the following documents:

FDIS	Report on voting
112/254/FDIS	112/262/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 60544 series, published under the general title *Electrical insulating materials – Determination of the effects of ionizing radiation*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

The establishment of suitable criteria for the evaluation of the radiation resistance of insulating materials is very complex, since such criteria depend upon the conditions under which the materials are used. For instance, if an insulated cable is flexed during a refuelling operation in a reactor, the service life will be that time during which the cable receives a radiation dose sufficient to reduce to a specified value one or more of the relevant mechanical properties. Temperature of operation, composition of the surrounding atmosphere and the time interval during which the total dose is received (dose rate or flux) are important factors which also determine the rate and mechanisms of chemical changes. In some applications, temporary changes may be the limiting factor.

Given this, it becomes necessary to define the radiation fields in which materials are exposed and the radiation dose subsequently absorbed by the material. It is also necessary to establish procedures for testing the mechanical and electrical properties of materials which will define the radiation degradation and link those properties with application requirements in order to provide an appropriate classification system.

ELECTRICAL INSULATING MATERIALS – DETERMINATION OF THE EFFECTS OF IONIZING RADIATION –

Part 1: Radiation interaction and dosimetry

1 Scope

This part of IEC 60544 deals broadly with the aspects to be considered in evaluating the effects of ionizing radiation on all types of organic insulating materials. It also provides, for X-rays, γ -rays, and electrons, a guide to

- dosimetry terminology,
- methods for dose measurements,
- testing carried out at irradiation facilities,
- evaluation and testing of material characteristics and properties,
- documenting the irradiation process.

Dosimetry that might be carried out at locations of use of the material is not described in this standard.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60544-2, *Electrical insulating materials – Determination of the effects of ionizing radiation on insulating materials – Part 2: Procedures for irradiation and test*

IEC 60544-4, *Electrical insulating materials – Determination of the effects of ionizing radiation – Part 4: Classification system for service in radiation environments*

3 Terms and definitions

For the purposes of this document, the terms and definitions in ICRU Report 33 [1]¹, as well as the following definitions apply.

3.1

exposure

X

measure of an electromagnetic radiation field (X- or γ -radiation) to which a material is exposed

Note 1 to entry: The exposure is the quotient obtained by dividing dQ by dm , where dQ is the absolute value of the total charge of the ions of one sign produced in the air when all of the electrons (and positrons) liberated by photons in air of mass dm are completely stopped in air:

¹ References in square brackets refer to the Bibliography.